

# **THE EFFECT OF PROBLEM- BASED LEARNING ON CRITICAL THINKING AND STUDENT ACHIEVEMENT IN THE 1 BANTUL SENIOR HIGH SCHOOL**

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## **Abstract**

The purposes of this study are (1) to know the effect of Problem-Based Learning on critical thinking, (2) to know the effect of Problem-Based Learning on student achievement, (3) to know the relationship between critical thinking and student achievement in Environmental Pollution of 10th Grade in The 1 Bantul Senior High School. The research was quasi experimental research using a control group pretest-posttest design. Sample was X IPA 5 as an experimental group while X IPA 6 as a control group. Data analysis techniques were normality and homogeneity test, t test, analysis of covariance (ANACOVA), and Pearson correlation. The results show that (1) Problem-Based Learning affects critical thinking, (2) Problem-Based Learning affects student achievement, and (3) there was a significant relationship between critical thinking and student achievement. The higher critical thinking is, the higher student achievement of the students.

**Keywords:** problem-based learning (PBL), critical thinking, student achievement

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## **1. Introduction**

The development of 21<sup>st</sup> century era pushes students to develop 21<sup>st</sup> century skills. Partnership for 21<sup>st</sup> Century Skills [1] has developed 21<sup>st</sup> century skills that consist of life and career skills, learning and innovation skills, and information media and technology skills. Teaching and learning process does not only increase student's knowledge but also develop student's creativity, critical thinking skill, characters which are included the character to has responsibility, social skills, tolerance, productivity, and adaptive skills. 21<sup>st</sup> century skills also emphasize on the ability to think critically, solve problem, communicate, and collaborate each others [2] that are included in Higher Order Thinking Skills.

Problem- Based Learning (PBL) is teaching and learning model that provide contextual problems to the classroom, so that teacher can stimulate students to learn [3]. PBL is a teaching and learning model that present many anuthentic problems and meaningfull to the students [4]. Teaching and learning process using PBL challenges students to learn, work in group to look for the solution in contextual problem. Teaching and learning process is directed to student in order to develop student's ability in making solutions systematically.

PBL has five characteristic that need to be considered by teachers before designing the

lesson plan using PBL model. The first characteristic is presenting essential question that is included problems. The others characteristic are PBL focuses on the relationship between interdisiplinary study, authentic investigation, publication of the artifact, and colaboration [4]. There are five operational steps from PBL, (1) giving orientation about the problem that will be discussed by student, (2) organizing students to do research, (3) helping students to investigate the problem, (4) developing and exhibiting the artefact, and (5) analysing and evaluating problem solving process [4].

Critical thinking is the process of complex thinking to analyse question or argument and generalize meaning and specific interpretation through logical thinking and understanding assumptions. The student's critical thinking ability can be identified by implementing proper teaching and learning model such as PBL model. Students who involved in PBL have critical thinking ability higher than students who involved in traditional teaching and learning model [5]. Teaching and learning process using PBL encourages student to think critically by presenting the extraordinary problems which the solution cannot be solved using common ways of thinking [6].

Student's achievment is student's skills that achived by students after teaching and learning process. One of student's achieiment that can be measured is cognitive aspect. According to

revised Bloom Taxonomy there are six aspects, (1) remember, (2) understand, (3) apply, (4) analysis, (5) evaluate, and (6) create [7].

There are several advantages using PBL as one of teaching and learning models. By using PBL increases student's understanding and increasing student's activities during teaching and learning process [8]. PBL helps students in transferring their factual knowledge to understand the contextual problem. PBL also develop student's responsibility and the most importantly is that PBL can increase the student's thinking ability. PBL brings the happiness in the classroom through teaching and learning process. By using PBL in classroom, it can increase student's critical thinking and also give student possibility to apply their knowledge in order to solve the problems.

One of senior high schools that has implemented 2013 curriculum is The 1 Bantul Senior High School. Biology teaching and learning process that is used using 2013 curriculum ideally should develop student's critical thinking skill. One of teaching and learning models that develop critical thinking skills is PBL. However, not all of the teaching and learning process has developed student's critical thinking skill. Teaching and learning process still conducted by teacher give whole information to students using conventional model such as question- answer method. Whereas, critical thinking skills do not merely appear instantly. It needs efforts to develop student's critical thinking skill. This skill, critical thinking, is ability that student should have in achieving learning mastery.

Learning material that is used in this study is environmental pollution. Environmental pollution choosed to be study material because it presents contextual problem that should be solved by student in daily life. This material bring problems that usually faced by student in their daily life. The implementation of PBL is on the Standard Competition 3.10 that it emphasizes on analysing data in environmental changing and the implication in environmental changing. In this material, students are confronted with environmental problem and are demanded to solve problems using critical thinking and also gathering information to solve problem systematically. This material provides dynamic environmental problem. Environmental problems tend to be complex and need to be solved using higher order thinking skills.

Based on the background above, there are three research question for this study (1) what is the effect of PBL to critical thinking?, (2) what is the effect of BL to student achievement?, and (3)

is there any relationship between critical thinking and students achievement in Environmental Pollution in The 1 Bantul Senior High School.

## **2. Method**

This study, which was carried out to know the effect of PBL to critical thinking and student achievement, was designed according to quasi experiment design using control group pretest-posttest design. This research is conducted in The 1 Bantul Senior High School, Bantul Regency, Special Region of Yogyakarta.

Population of this study was students of 10<sup>th</sup> grade of Science Program in The 1 Bantul Senior High School, which was consisted of two classes, 10<sup>th</sup> Science Program 5 as experimental group and 10<sup>th</sup> Science Program 6 as control group.

The dependent variable of this study was PBL that consists of five steps, (1) problem orientation, (2) study organization, (3) individual and group investigation, (4) presentation, and (5) analysis and evaluation. The independent variables in this study were critical thinking and student's achievement focuses on cognitive aspect.

The study conducted by determining experiment group and control group by giving treatment which was PBL for experiment group and conventional model for control group. Extraneous variables were also controlled. Data was collected using test (pre test- post test), the implementation of PBL, and student evaluation about the implementation of PBL in class. After data had been taken, data was analysed.

Collected data in this study were observation sheets, videos, photos, student's critical thinking skills data, and student's achievement data in cognitive aspect. Instruments that were used in this study were instrument to collect the implementation of PBL, instrument to collect the student's critical thinking skills and also student's achievement in cognitive aspect.

The data obtained in the study were analysed using SPSS package program. Data analysis that were used were normality test and homogeneity test. To know the difference between two groups, T test was used in order to know the difference between experiment group and control group. To know the difference between two groups before and after the implementation of PBL, Pair sample T test was also used. Covariance analysis is also used to know the influence of covariance to the dependent variables. The relationship between variables were analysed using Pearson Correlation Test.

### 3. Result

Descriptive analysis was conducted to describe the student's critical thinking skills and student's achievement. According to descriptive analysis, experiment group had higher result in critical thinking skills and student achievement than control group.

Table 1. Descriptive Analysis of Student's Critical Thinking Skills and Student's Achievement

	Control Group		Experiment Group	
	CT	SA	CT	SA
Mean	66,11	69,33	77,50	79,57
Median	70	72	80	80
Mode	65	76	75	68
Max	85	88	100	100
Min	35	56	35	68
STDV	18,47	16,34	15,37	8,73

CT= Critical Thinking

SA= Student Achievement

\*= significant different

As seen on the table above, it was understood that experiment group has higher average on critical thinking (77,50) and student's achievement (79,57) than control group which has 66,11 for critical thinking and 69,33 for student's achievement.

According to Independent Sample T test, there was a significant difference between the median of critical thinking ability (sig. 0,016) and student achievement (sig 0,005) which was showed by the sig 0,05. According to the result of Paired Sample T Test, there was a difference between before and after the implementation of PBL in experiment group, whereas there is no difference in control group before and after the learning process.

Table 2. Pair Sample T- test Result

Group	Aspect	Sig	Result
Control	Critical thinking	0,805	Not difference
	Student achievement	0,0006	Difference
Experiment	Critical thinking	0,014	Difference
	Student achievement	0,000	Difference

According to Covariance Analysis, there was an effect of PBL to student's critical thinking ability and student's achievement which was

shown by the sig 0,016 for critical thinking and 0,006 for student achievement.

Table 3. Covariance Analysis

Dependent variable	Sig
Critical thinking	0,016
Student achievement	0,006

The result of Pearson Correlation Test to independent variables, critical thinking and student achievement, shows that there was a relationship between student critical thinking ability and student achievement. Correlation coefficient in critical thinking and student achievement was 0,406. It means that two independent variables, critical thinking and student achievement, had significant correlation (sig= 0,032). The correlation between critical thinking and student achievement is positive correlation. It means that the higher critical thinking was, the higher student achievement of the students after involving PBL class.

### 4. Discussion

The difference results between control group and experiment are caused by students in experiment group involve in PBL classroom which is student- centered learning. PBL gives students opportunities to actively participate during learning process. Students actively discuss for solving the problems provided by teacher about the environmental pollution. Students are encouraged to solve the problem using analytical thinking and also encourage them to apply their knowledge in order to solve the given problems. These activities are developing student critical thinking because student are also encouraged to seek and gather the information relating to the problem they will solve. Students are also analysing and associating the relationship between information relating to the problems. Through all these activities, students have opportunities to think deeply about the environmental concepts that they get through thinking activities during problem solving activities. All those activities are also increasing student's understanding about environmental pollution which has influence to student achievement especially cognitive aspect.

Critical thinking is the activity to think about facts or information in order to make conclusion which involves the lower- order thinking activities and higher order thinking activities. High- order thinking skills consist of the ability to analysis, evaluate, and create that are represented as critical thinking skills [9].

Critical thinking skills that is measured are the ability to make interpretation, inference, explanation, analysis, and evaluation. There skills are increasing during PBL teaching and learning process because PBL highly motivate and encourage student to use their thinking ability. According to the result study shows that critical thinking skill has correlation with student achievement especially in cognitive aspect which has been stated by revised Bloom Taxonomy. Analysis, evaluate, and create are three level of revised Bloom Taxonomy that represent the critical thinking skills. It can be concluded that the higher critical thinking is, the higher student achievement especially in cognitive aspect.

The results show that (1) Problem- Based Learning affects critical thinking, (2) Problem-Based Learning affects student achievement, and (3) there was a significant relationship between critical thinking and student achievement. The higher critical thinking is, the higher student achievement of the students.

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